

A NEW CRAYFISH OF THE GENUS *PROCAMBARUS* FROM SOUTHWESTERN ARKANSAS

Horton H. Hobbs, Jr., and Henry W. Robison

Abstract.—*Procambarus (Girardiella) parasimulans* is described from the Ouachita and Red river basins of southwestern Arkansas. Its relationships to *P. (G.) curdi* Reimer and *P. (G.) simulans* (Faxon) are discussed.

Comparatively little attention has been accorded the crayfishes of Arkansas occurring south of the Arkansas River basin. The review of Bouchard and Robison (1981) summarizes the currently known fauna, but details of the distribution of few of the species have been recorded by anyone. For obvious reasons, the primary and secondary burrowers belonging to the genus *Fallicambarus* and to the subgenus *Girardiella* of the genus *Procambarus* are poorly represented in collections, and first form males are rare among the few series that are available. The species described herein first came to our attention in a single collection made in Sevier County in 1973 (see "Range and specimens examined"); however, not until subsequent field work by one of us (H.W.R.) resulted in obtaining additional material were the available specimens considered adequate for preparing a description. Moreover, in view of the unpublished study by Rollin D. Reimer, we were and remain hesitant to describe crayfishes that almost certainly had been recognized as undescribed by him. In view of no response to our attempts to communicate with Dr. Reimer, however, we offer this description.

Procambarus (Girardiella) parasimulans, new species
Fig. 1

Diagnosis.—Body pigmented, eyes well developed. Rostrum of adults without marginal spine and median carina. Carapace lacking cervical spine or tubercle. Areola 5.1 to 9.0 (average 6.6 ± 0.9822) times as long as broad and constituting 30.0 to 35.0 (average 32.5) percent of total length of carapace (37.8 to 42.3 (average 39.9) percent of postorbital carapace length). Suborbital angle weak, lacking spine or tubercle in adult. Hepatic area weakly tuberculate; branchiostegal spine reduced to weak tubercle. Antennal scale about twice as long as broad, widest at, or slightly distal to, midlength. Ventral surface of chela strongly tuberculate, tubercles present along proximal half of ventral surface of dactyl. Ischium of third pereopod of first form male with simple, strong hook overreaching basioischial articulation; hook not opposed by tubercle on corresponding basis; coxa of fourth pereopod lacking caudomesial boss. First pleopods of first form male reaching coxae of third pereopods, symmetrical, bearing proximomesial spur at caudal proximomesial angle and subtruncate cephalic shoulder at base of terminal elements, lacking subterminal setae; terminal elements (all at least partly cornified) consisting of (1) long, slightly curved mesial process reaching beyond other elements distally; (2) small, weakly curved, cephalodistally directed cephalic process at cephalic base of mesial process; (3) similarly disposed, strongly cornified,

clawlike central projection arising from between mesial and caudal processes; and (4) very conspicuous caudal process rounded, spatulate, and disposed cephalodistally. Female with annulus ventralis about 1.5 times as broad as long, subsymmetrical in outline, with curved cephalomedian trough, flanked by rows of prominent tubercles (or at least by a scalloped wall), leading to sigmoid sinus, latter ending near median line anterior to caudal margin of annulus; preannular plate not recognizable; postannular sclerite about 0.7 as wide and little more than 0.5 as long as annulus, broadly rounded anteriorly and weakly elevated ventrally; first pleopod present.

Holotypic male, form I: Cephalothorax (Fig. 1*a*, *o*) subovate, weakly compressed laterally; maximum width of carapace slightly greater than height at caudodorsal margin of cervical groove (17.8 and 17.3 mm). Abdomen narrower than thorax (14.1 and 17.8 mm). Areola 7.1 times as long as wide, with 1 to 3 punctations across narrowest part. Cephalic section of carapace about 1.8 times as long as areola, latter comprising 34 percent of total length of carapace (41.3 percent of postorbital carapace length). Surface of carapace punctate dorsally except in polished gastric area anterior to articular level of cardiac stomach, granulate laterally, and weakly tuberculate in hepatic region. Rostrum broad with weakly convergent margins turning suddenly anteromesially over penultimate podomere of antennular peduncle and ending in slightly upturned tip at base of ultimate podomere of peduncle; margins not conspicuously thickened; upper surface concave with submarginal rows of punctations, very few others except clusters of several larger ones on lateral sides of median depression at rostral base. Subrostral ridge weak, barely perceptible except along caudal margin of orbit. Postorbital ridge rather weak, neither swollen caudally nor with tubercle or spine cephalically. Suborbital angle and branchiostegal spine both weak, latter consisting of hardly more than very small tubercle and only slightly larger than those tubercles flanking ventral side of cephaloventral part of cervical groove. Cervical spine absent.

Abdomen only little longer than carapace (36.3 and 35.6 mm). Pleura of third through fifth segments subtruncate ventrally and rounded caudoventrally. Cephalic section of telson with 4 spines (that next to lateralmost movable) in each caudolateral corner (Fig. 1*k*). Cephalic lobe of epistome (Fig. 1*m*) subtriangular with weakly undulating, somewhat thickened, anterolateral margins; median surface arched ventrally; main body of epistome with subtriangular depression marking area usually occupied by median fovea; epistomal zygoma broadly arched. Ventral surface of proximal podomere of antennular peduncle with heavy short spine just proximal to midlength. Antennular peduncle with short distolateral spine on basis; ischium without ventral spine or tubercle; flagellum broken but reaching base of fifth abdominal segment. Antennular scale (Fig. 1*n*) about twice as long as broad, widest at about midlength; greatest width of lamellar area almost 3 times that of thickened lateral part.

Third maxilliped extending as far anteriorly as antennular peduncle, distinctly overreaching antennular peduncle; mesial sector of ventral surface of ischium with crowded long stiff setae, lateral sector with submarginal row and scattered short, more delicate plumose setae; merus similarly clothed.

Right chela (Fig. 1*r*) subovate in cross-section, somewhat depressed; palm approximately 1.2 times as broad as length of mesial margin; latter almost one-

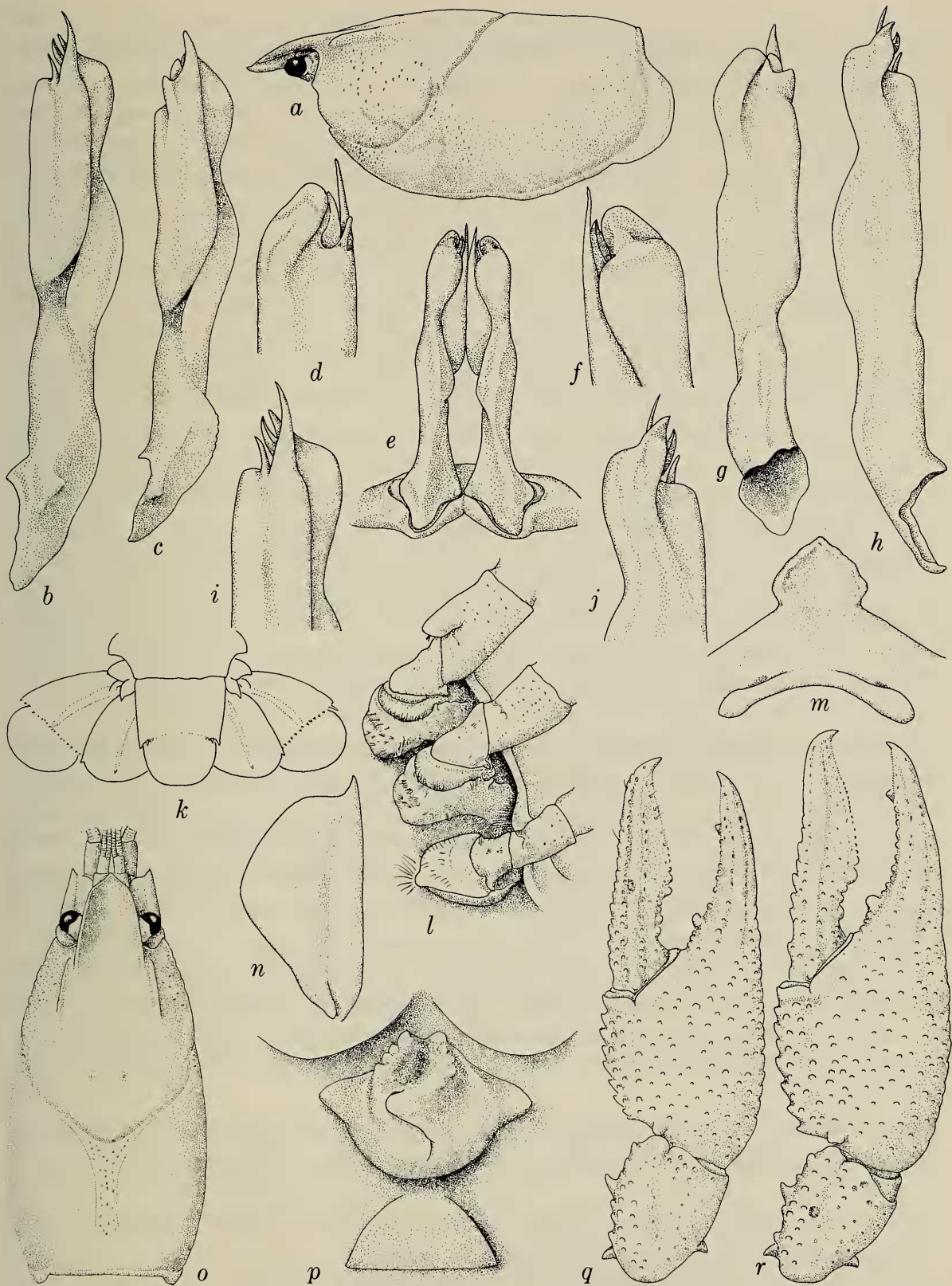


Fig. 1. *Procambarus* (*G.*) *parasimulans* (*a*, *b*, *d*-*f*, *h*-*o*, and *r* from holotype; *c*, *g* from morphotype, and *p*, *q* from allotype): *a*, Lateral view of carapace; *b*, *c*, Mesial view of first pleopod; *d*, Cephalic view of distal part of first pleopod; *e*, Caudal view of first pleopods; *f*, Caudal view of distal part of first pleopod; *g*, *h*, Lateral view of first pleopod; *i*, Mesial view of distal part of first pleopod; *j*, Lateral view of distal part of first pleopod; *k*, Dorsal view of telson and uropods; *l*, Ventral view of basal podomeres of third, fourth, and fifth pereiopods; *m*, Epistome; *n*, Antennal scale; *o*, Dorsal view of carapace; *p*, Annulus ventralis and adjacent sternal features; *q*, *r*, Dorsal view of distal podomeres of first pereiopod.

third total length of chela; except for narrow ventrolateral area and ventro- and dorsomedian ridges on fingers, surface studded with squamous to subsquamous tubercles. Mesial margin of palm with row of 7 (left with 8) tubercles flanked dorsally and ventrally by 2 sublinear series and few additional tubercles. Both fingers with low median longitudinal ridges dorsally and ventrally; ridges flanked proximally by squamous tubercles and distally by punctations. Opposable margin of fixed finger with row of 15 (left with 10) tubercles (fourth, third on left, from base largest) of which some of more distal ones so small that not depicted in illustration; row reaching base of distal third of finger; large, subtriangular tubercle present on lower level at base of distal fourth of finger; opposable margin also bearing row of minute denticles, interrupted by tubercles, extending from seventh tubercle from base of finger to proximal end of corneous tip of finger. Opposable margin of dactyl distinctly excised proximally, bearing row of 19 (left with 16) tubercles (fourth from base largest) along proximal two-thirds, and minute denticles opposing those on fixed finger; mesial margin of dactyl with row of 10 tubercles along proximal two-thirds of finger, tubercles decreasing in size and becoming more squamous toward distal end of finger.

Carpus of cheliped longer than broad with sinuous furrow dorsally; furrow flanked by tubercles mesially and distolaterally and punctations proximolaterally; mesial surface of podomere with 5 (left with 7) tubercles, that near midlength largest, ventromesial surface with cluster of tubercles and ventrodial margin with usual 2 tubercles, none lateral to that serving as condyle ventrolaterally.

Merus with dorsal tubercular band extending from base almost to distal end of podomere, band originating in single row and broadening and becoming generally more conspicuous distally; mesial and lateral surfaces comparatively smooth; ventral surface with mesial row of 17 (left with 15) tubercles, lateral row of 8 (left with 7), and distal oblique row of 3 joining mesial and lateral rows; 3 small tubercles in row along lateral side of distal articular membrane of podomere and another small one at base of distolateral condyle. Ischium with row of 6 (left with 5) tubercles ventromesially.

Hook on ischium of third pereopod (Fig. 1*l*) simple, heavy, thumblike, and overreaching basioischial articulation, not opposed by strong tubercle on basis but rudiment of one present on basis of left pereopod. Coxa of neither fourth nor fifth pereopods with boss, but ventral caudomesial angle of fifth slightly produced.

Sternum between third, fourth, and fifth pereopods comparatively shallow but ventrolateral margins bearing fringe of plumose setae, latter not concealing first pleopods.

First pleopods (Fig. 1*b, d-f, h-j*) as described in "Diagnosis." In addition, proximomedian lobe moderately long.

Uropods (Fig. 1*k*) with both lobes of proximal podomere bearing short, acute spines; mesial ramus with distomedian spine small and situated distinctly pre-marginally.

Allotypic female: Differing from holotype, other than in secondary sexual features, in following respects: rostrum with margins more strongly convergent and acumen more distinctly delimited; branchiostegal spine more spiniform but hardly more conspicuous; cephalic section of telson with only 2 spines in each caudolateral corner, more mesial of which movable; third maxilliped overreaching an-

Table 1.—Measurements (mm) of *Procambarus (G.) parasimulans*.

	Holotype	Allotype	Morphotype
Carapace:			
Entire length	35.6	38.9	28.7
Postorbital length	29.3	32.2	23.7
Width	17.8	19.2	14.2
Height	17.3	18.4	13.4
Areola:			
Width	1.7	2.2	1.5
Length	12.1	12.8	9.6
Rostrum:			
Width	6.1	6.3	4.6
Length	8.1	8.2	6.1
Chela:			
Length, palm mesial margin	11.3	7.8	6.1
Palm width	13.3	10.1	7.6
Length, lateral margin	32.9	24.4	18.4
Dactyl length	20.0	14.7	11.3
Abdomen:			
Width	14.1	16.3	10.9
Length	36.3	40.8	29.1

tenal peduncle by length of distal podomere, ischium and merus much less strongly hirsute; mesial margin of palm of chelae (Fig. 1*q*) with row of 8 tubercles, opposable margin of fixed finger of chela with row of 11 (13 on left) tubercles, row of minute denticles originating at distal base of first tubercle in row and becoming band for short distance beyond triangular tubercle on lower level; opposable margin of dactyl of chela with row of 14 (12 on left) tubercles and row of minute denticles originating immediately distal to tubercle marking distal margin of excised area of finger; mesial surface of carpus of cheliped with row of 7 tubercles; ventral surface of merus with mesial row of 15 (17 on left) tubercles and lateral one of 8, oblique row of 2 (right) or 3 (left), and only 2 in row flanking articular membrane of right chela; ischium with row of 4 (right) or 5 (left) tubercles.

Annulus ventralis (Fig. 1*p*) as described in "Diagnosis."

Morphotypic male, form II: Differing from holotype in following respects: branchiostegal spine distinctly spiniform; cephalic section of telson with 2 spines in each caudolateral corner, more mesial one movable; shallow median fovea present in main body of epistome; ischium of antennal peduncle with small tubercle on ventral surface; antennal flagellum reaching third abdominal tergum; antennal scale broadest slightly anterior to midlength; third maxilliped reaching very little beyond antennal peduncle; mesial margin of palm of chela with row of 7 tubercles; opposable margin of fixed finger with row of 10 tubercles (third from base largest) and that of dactyl with 13 (right) or 12 (left) tubercles, fourth from base largest; mesial surface of carpus with 6 tubercles; ventral surface of merus with lateral row of 9 (right) or 10 (left) tubercles, mesial row of 15 (right) or 19 (left), and oblique row of 4 tubercles; ventromesial margin of ischium with row of 4 tuber-

cles; ischium of third pereopod tuberculiform and not attaining basioischial articulation; sternum between third, fourth, and fifth pereopods shallow, and setae on ventrolateral margins not so well developed.

First pleopod (Fig. 1c, g) with 4 elements represented but none corneous, and juvenile suture evident. All terminals more robust but disposed as in first form male.

Color notes.—(Based upon specimens from Hot Spring and Sevier counties, Arkansas.) Carapace pale tan dorsally fading to cream ventrolaterally. Dark brown stripe on ventral flank of postorbital ridge and another extending ventrally across orbital and antennal areas, setting off marginal, subtriangular cream marking on antennal and upper anteroventral branchiostegal regions. Hepatic area with paler brown reticulations; pale to dark brown pattern covering most of paired mandibular adductor regions, these patches joined by narrow dark band along antero-median margin of cervical groove. Branchiostegites with large, dark brown areas dorsolaterally and somewhat paler brown reticulate stripe more ventrally, latter extending from cervical groove almost to posterior margin of carapace. Abdomen, like carapace, tan dorsally (however, some specimens with tergum of first segment dark brown) fading ventrally to very pale tan and marked by 2 pairs of scalloped dark stripes: more dorsal one darker and extending caudally from level of upper patch on branchiostegite and terminating on sixth tergum; more ventral stripe, corresponding in level to ventral stripe on branchiostegite, consisting of ventrally convex arcs along bases of pleura; latter with cream to white spots. Uropods tan with brown reticulations, and lateral ramus with dark brown lateral border. Antennules mostly dark brown; antennal peduncle tan with dark splotches, and lateral border of antennal scale also quite dark. Dorsal surface of cheliped much darker than ventral, dark brown reticulations most conspicuous along dorsal edge and on distal border of merus, and only slightly less so on dorsum of carpus, on dorsomesial part of palm, and on dorsal surface of dactyl; dark coloration becoming more dilute laterally on both palm and fixed finger of chela. Remaining pereopods, especially third and fourth, with brown reticulations dorsally from ischium almost to distal extremity of propodus, darkest on contiguous parts of merus and carpus, from which fading proximally and distally.

Type-locality.—An unnamed tributary to Prairie Bayou (Ouachita River basin), 10.2 miles east of Bismarck on State Route 84 (Sec. 35, R 19W, T 4S), Hot Spring County, Arkansas. The crayfish were collected from shallow (8 to 16 cm) marginal pool area choked with dense mats of filamentous algae and decaying organic material on the south side of the road. The small springfed woodland stream originates just north of the highway in a mixed *Quercus-Pinus* forest and flows under the highway, through a pasture, and southward to join Prairie Bayou. The stream bed consists of sandy clay interspersed with gravel, and grasses and sedges flank its banks.

Disposition of types.—The holotype, allotype, and morphotype are deposited in the National Museum of Natural History (Smithsonian Institution), nos. 177698, 177699, and 177700, respectively, as are the paratypes consisting of 2 ♂I, 11 ♂II, 12 ♀, 36 j♂, 47 j♀. See "Range and specimens examined" for restricted list of types.

Size.—The largest specimen available is a first form male, from Sevier County, that has a carapace length of 42.5 mm (postorbital carapace length 24.4 mm);

corresponding lengths of the smallest first form male and largest female are 31.3 (25.8) mm and 39.6 (33.4) mm. Females carrying eggs or young are unknown.

Range and specimens examined.—All of the specimens of this crayfish of which we are aware were collected in tributaries of the Ouachita and Red rivers in southwestern Arkansas. In the following list of specimens examined, only those lots marked by an asterisk constitute the type-series. CLARK COUNTY: (1) small stream and roadside ditch 1.0 mi E of Amity on St Rte 84, 1 j♂, 21 Apr 1973, J. E. Pugh, G. B. Hobbs, and HHH; (2) Wingfield Creek 0.5 mi E of St Rte 53 on timber access road, 2 j♂, 1 j♀, 8 Apr 1974, HWR; (3) Rest Haven Cemetery about 4 mi W of Arkadelphia on St Rte 8, 1 ♂II, 28 Feb 1981, HWR; (4)* creek 14.8 mi W of Bismarck on St Rte 84, 7 ♂II, 4 ♀, 8 j♂, 10 j♀, 13 Mar 1981, HWR. GRANT COUNTY: (5) creek 7.3 mi E of Poyen on St Rte 270, 2 ♀, 1 j♂, 19 Mar 1980, HWR. HOT SPRING COUNTY: (6)* trib to Prairie Bayou 10.2 mi E of Bismarck on St Rte 84, 1 ♂I, 2 ♂II, 9 j♂, 8 j♀, 17 Mar 1980, HWR; 2 ♀, 6 j♂, 10 j♀, 13 Mar 1981, HWR; 1 ♂I, 1 j♂, 3 Apr 1981, HWR; (7)* roadside ditch 6.4 mi W of Bismarck on St Rte 84, 2 ♂II, 3 ♀, 11 j♂, 16 j♀, 17 Mar 1980, HWR; (8) trib to Point Cedar Creek 21 mi E of Point Cedar on St Rte 84, 1 j♀, 13 Mar 1981, HWR. NEVADA COUNTY: (9) De Ann Cemetery in Prescott, 2 ♂II, 2 ♀, 16 j♂, 16 j♀, 28 Feb 1981, HWR. OUACHITA COUNTY: (10) trib to Two Bayou between St Rtes 4 and 24, 1 ♂II, 1 j♂, 4 j♀, 30 Mar 1975, S. O. Pelt. PIKE COUNTY: (11) roadside ditch 2.0 mi E of Daisy on U.S. Hwy 70, 9 j♂, 6 j♀, 21 Apr 1973, JEP, GBH, HHH. SEVIER COUNTY: (12) seepage area 5.0 mi NE of U.S. Hwy 59-71 on U.S. Hwy 70, 1 ♂I, 1 ♂II, 4 ♀, 1 j♂, 3 j♀, 20 Apr 1973, JEP, GBH, HHH.

Variations.—Most of the specimens at hand were collected in the Ouachita River basin and exhibit a rather remarkable uniformity. Among the juveniles, however, many of those with carapace lengths of 10 to 14 mm have rostra with small marginal spines that appear to become reduced to angles with subsequent molts, and, in most individuals, even the angles disappear completely before the animal reaches sexual maturity. Among 15 juveniles from locality 11, those with a carapace length greater than 14 mm do not have even a trace of the marginal spines on the rostrum or spines on the postorbital ridges. Some juveniles from several of the localities lose both the marginal and postorbital spines by the time they have attained a carapace length of 7 mm. In contrast, juveniles from locality 12 still have rostral and postorbital spines at a carapace length of 13 mm. The juveniles from locality 9, Nevada County, have proportionately narrower areolae than do those from the other localities. In only one of the adults (one from Sevier County) is there even the slightest subangular curve marking the base of the acumen that is so evident in the smallest juveniles. Also the fingers of the chela of the single first form male from the same locality in Sevier County are slightly more bowed than they are in the two first form specimens from Hot Spring County. Inadequate series are available from the two river basins to ascertain whether or not populations from them exhibit distinguishing features. Series of adults from both drainage systems are much needed.

Relationships.—*Procambarus* (*G.*) *parasimulans* has its closest affinities with *P.* (*G.*) *simulans* (Faxon, 1884:112) and *P.* (*G.*) *curdi* Reimer (1975:22). From *P.* (*G.*) *simulans* it differs markedly in features of the cheliped: the chela is not only more robust in *P.* (*G.*) *parasimulans* but it is also studded with more tubercles—

Table 2.—Ratios of carapace lengths and areolar lengths and widths.

Crayfishes		Ratios		
		1*	2**	3†
<i>P. (G.) parasimulans</i> (n = 34)	Range	30.0–34.5	37.8–42.3	5.1–9.0
	Mean	32.5 ± 1.2440	39.9 ± 0.9619	6.6 ± 0.9822
<i>P. (G.) simulans</i> (n = 15)	Range	33.7–35.5	42.2–44.2	6.5–13.4
	Mean	34.7 ± 0.6488	43.4 ± 0.5738	10.2 ± 1.9779
<i>P. (G.) curdi</i> (n = 2)	Range	36.1–37.5	44.0	14.6–16.0

* Areola length/Carapace length × 100. ** Areola length/Postorbital length × 100. † Areola length/Areola width.

on the ventral surface distributed over the proximal half of the fingers, and on the dorsal face of the dactyl, from base to midlength. Almost equally obvious is the difference in the shape of the telson, which is narrower and more tapering in the new species. The rostrum of the latter is also strikingly different in that the margins are distinctly more gently convergent, almost all adult specimens lacking even a suggestion of angles at the base of the acumen. Whereas the range of variation in the relative length and width of the areola in the two overlap to some extent, the areola of *P. (G.) parasimulans* is almost always shorter and broader (see Table 2). The first pleopod of the first form male exhibits few differences: the shoulder at the cephalic base of the terminal elements is less arched in *P. (G.) parasimulans*, the flat surface of the caudal process lies more nearly parallel to the transverse plane of the body, and the proximomesial spur is borne on the caudal proximomesial angle of the appendage rather than being situated slightly more laterally as in *P. (G.) simulans simulans*. Also the postannular sclerite of the female is broadly rounded anteriorly in the new species rather than being subtriangular.

The most obvious feature that distinguishes it from *P. (G.) curdi* is the areola which is no more than 9 (as contrasted with 14 to 16) times as long as broad. The postaxial surface of the ischium of the third maxilliped is much less hirsute, and there are distinct differences in the first pleopod of the males of the two: the central projection of *P. (G.) parasimulans* extends neither so far distally nor laterally beyond the caudal process; in *P. (G.) parasimulans* the latter is obliquely compressed, not mesiolaterally as it is in *P. (G.) curdi*.

This crayfish may be distinguished from the other species of the subgenus *Girardiella* that have been reported to occur in Arkansas (see review by Bouchard and Robison 1981) as follows: except for *P. (G.) tulanei* Penn (1953:163), which may be recognized by the bearded mesial surface of the palm of the chela, the areolae of these distant relatives [*P. (G.) gracilis* (Bundy, 1876:5), *P. (G.) liberorum* Fitzpatrick (1978:533), and *P. (G.) reimeri* Hobbs, 1979:804)] are at least 16 times as long as wide, considerably narrower than that of *P. (G.) parasimulans* of which no representative has been examined that has an areola greater than 9 times as long as wide.

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description is based and to J. F. Fitzpatrick, C. W. Hart, Jr., and H. H. Hobbs III for their criticisms of the manuscript.

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(HHH) Department of Invertebrate Zoology, Smithsonian Institution, Washington, D.C. 20560; (HWR) Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71753.